



US006377679B1

(12) **United States Patent**  
**Hashimoto et al.**

(10) **Patent No.:** **US 6,377,679 B1**  
(45) **Date of Patent:** **Apr. 23, 2002**

(54) **SPEAKERPHONE**

(75) **Inventors:** **Hiroshi Hashimoto; Yoshiro Nishimoto; Tetsuya Takahashi**, all of Kobe; **Akira Nakazumi**, Osaka; **Masahiro Nishisaka**, Osaka; **Toru Takahashi**, Osaka; **Masahiko Toyoshima**, Osaka, all of (JP)

(73) **Assignee:** **Kabushiki Kaisha Kobe Seiko Sho**, Kobe (JP)

(\*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) **Appl. No.:** **08/993,412**

(22) **Filed:** **Dec. 18, 1997**

(30) **Foreign Application Priority Data**

Dec. 26, 1996 (JP) ..... 8-348228  
Dec. 26, 1996 (JP) ..... 8-348229

(51) **Int. Cl.<sup>7</sup>** ..... **H04M 11/00**

(52) **U.S. Cl.** ..... **379/388.05; 379/390.01; 379/388.01**

(58) **Field of Search** ..... **379/388.05, 388.06, 379/388.07, 390.01, 390.02, 388.04, 388.01**

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

4,901,346 A \* 2/1990 Erving ..... 379/388.06

\* cited by examiner

*Primary Examiner*—Stella Woo

(74) *Attorney, Agent, or Firm*—Reed Smith LLP

(57) **ABSTRACT**

The conventional speakerphone using the voice switch, when combined with the echo canceler, involves a problem that the threshold for switching the transmit/receive state of the voice switch cannot comply smoothly and stably with the performance variation of the echo canceler, thereby obstructing echo canceling in a manner that the voice switch cooperates with the echo canceler.

The speakerphone of the invention estimates the performance variation of the adaptive filter by using the integrated value of a power of the receive signal or the transmit signal referred in the past when the adaptive filter learns, and varies the threshold in accordance with the performance variation. Thus, the speakerphone of the invention achieves a stable communication system that approaches to the full duplex with the voice switching system and the echo canceling system combined.

**12 Claims, 11 Drawing Sheets**

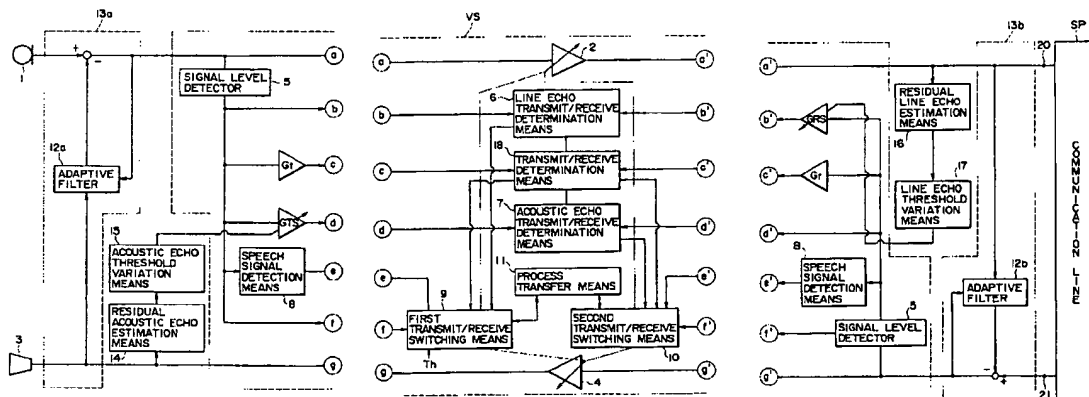


FIG. 1A

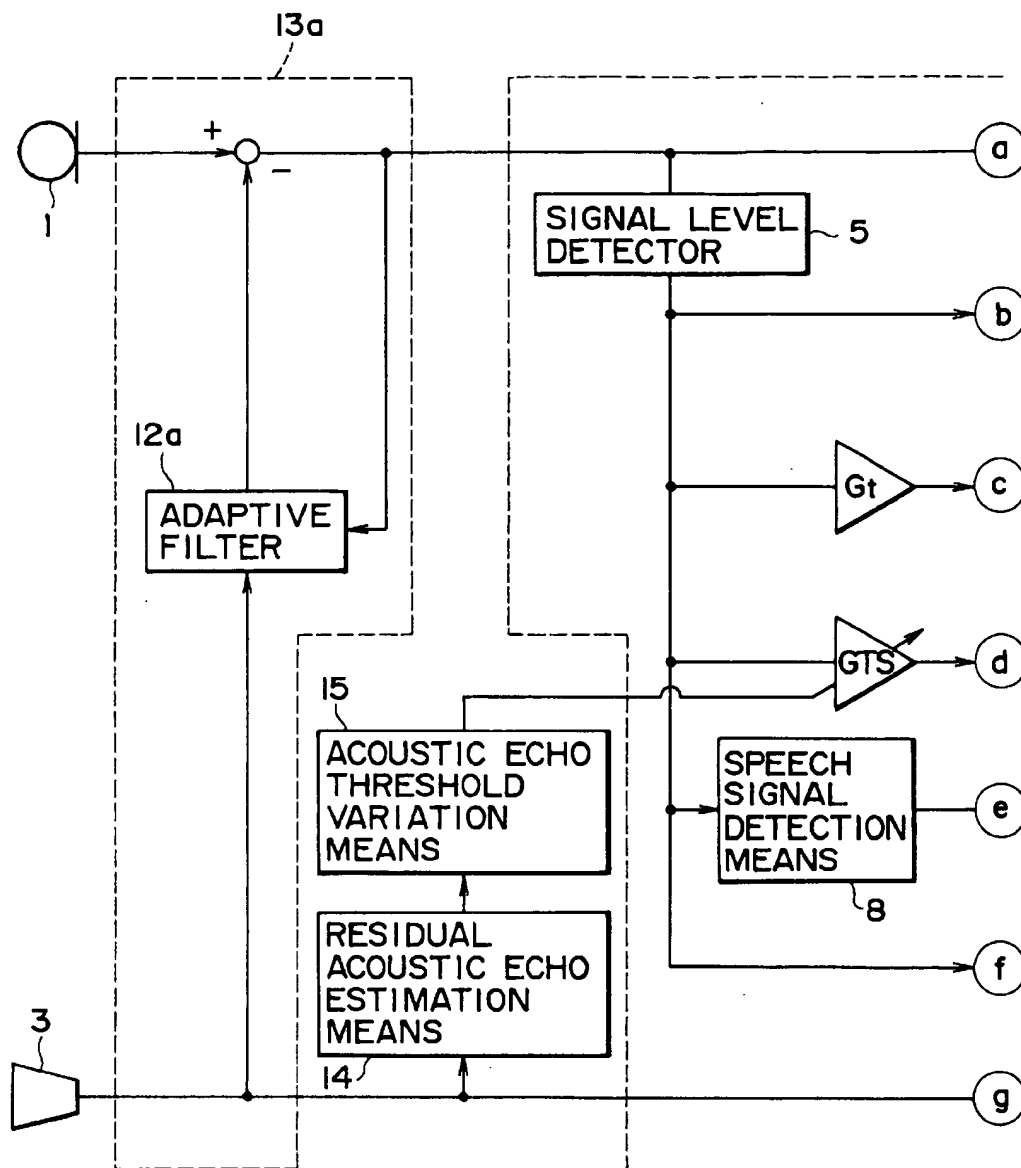


FIG. 1

